breech-plug.

MAKING GREAT GUNS.

THE ORDNANCE FACTORIES OF THE UNITED STATES.

A NEW AND IMPORTANT INDUSTRY FIRMLY ESTABLISHED-WHAT A VISITOR SAW IN THE BUSY WORKSHOPS-CHANGES WROUGHT IN SEVEN YEARS-MORE THAN 100 GUNS OF AMERICAN STEEL NOW AFLOAT-

ARE MANUFACTURED-MODERN GUNS AND GUN-MAKING DE-

SOM BED-GUN CARRIAGES. AND PROJECTILES.

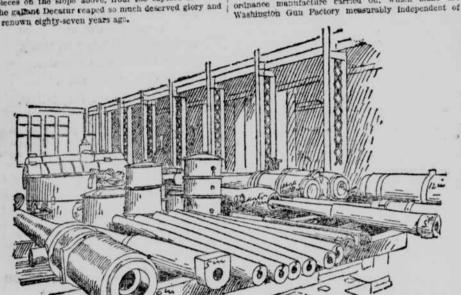
Just within the gateway of the Washington Navy Yard, and a few feet to the eight and left of the tall flagstaff, are mounted two bronze smooth-bore cannon of antiquated type and manufacture. They were made, as the foundry marks show, at Barcelona, Spain, in the year 1788. A square of tin, originally painted black, which is attached to each gun, bears an inscription in letters once white, but now stained and balf-effaced by time and weather, which informs the curious visitor that these pieces are war trophies taken from two Tripolitan gundoats, which were attacked and captured in 1804 by a gunboat commanded by Captain Stephen Decator, of the United States Navy. A few yards beyond these trophies, at the foot of a teep slope, stand the great gun shops and offer buildings that shelter the Washington Naval Gun Factory, which in its present form is virtually a creation of the last three years, and which cannot yet be regarded Here have been built and are now building modern steel guns, a single shot from one of which would silence a score of guns like the puny bronze pieces on the slope above, from the capture of which the gallant Decatur reaped so much deserved glory and

for the rapid-firing guns of smaller calibre. The "mount" for a modern heavy gun—say, the hydraulic carriage just completed for one of the 10-inch guns of the Miantonemoh—strikes the visitor as a complicated and wonderful piece of mechanism, and his sense of hewilderment becomes more acute than before if he attempts to gain even a glimmering idea of the uses and functions of its favored parts and continues. uses and functions of its several parts and appliances. "Mounts" for guns of nearly a dozen different calibres and in all stages of development surround him in what, to his unskilled eye, seems to be inextricable onfusion; the 25-ton overhead-travelling crane is in almost constant motion, and two huge standing cranes - which bring to mind the building of the first 6-inch gun a few years ago-hold out their giant arms ready to lift and carry great burdens. It is a scene of busy activity, for guns are being turned out rapidly to meet the demands for the new shtps; and grins, like cavalry troops, are of little use unless properly mounted. Every gun-carriage, when completed, is sent to the proving-ground and thoroughly tested be fore it is issued. Two 19-inch carriages are well advanced, and will be completed by the time that the first two guns of that calibre are ready to be mounted

The visitor next enters the shop where busy workmen are making projectiles. These range in size from four-tuch to ten-inch, and include shell and shrapnel, and at present are made of castiron. the visitor they seem to be hard enough and tough enough for all practical purposes, but the Ordnance people inform him that he is mistaken, and that the will not be satisfied until they have succeeded in prowill not be satisfied until they have succeeded in pro-ducing steel shells which will pierce the sides of an enemy's ship without "deformation." This solicitude on account of "deformation" does not appear to extend to the possible chemy or his ships. The visitor is further informed that steps have been taken, which will result in the manufacture in the United States of Firming and Haltzer steel projectiles for use agains armored vessels, and that within a reasonable time a sufficient supply of them will be obtained to meet the

demands of the new navy.

In other shops the visitor finds many branches of ordnance manufacture carried on, which make the



as the "North Gun Shop" and the "South Gun Shop." of such guns are being made. In another department ander the same roof, making a room 630 feet long and ninety-five to 135 feet wide—is one chiefly of bewilder—in another building contains the boilers. mense gun-shops-for there are two, known respectively ment, and that impression he does not lose even after hours of survey and study. He thinks he is reminded verse of "The Charge of the Light Brigade," which he feebly and vainly tries to repeat. In front and below him is an immense hollow thing of steel that slowly revolves by the power of machinery, which works almost noiselessly, and a dozen men are busy doing something both to the inside and outside of the monster. When completed this thing will be a twelve-inch breech-loading rifle. It will be nearly thirtyseven feet long and nearly four feet high at its greatest ster, and will weigh about 101,000 pounds. With a powder-charge of 425 pounds, it will carry a steel projectile weighing 850 pounds a distance of twelve niles with a velocity great enough to perforate a steel plate more than two feet in thickness if placed at the nuzzle. Near by lies the huge tube of another twelvewhich has been brought and deposited here by the 110-ton overhead travelling crane at easily and gently as a mother would carry her sleeping babe to its cradle. The same crane is now bringing from the shrinking pit an immense black-hot steel "hoop," which is quickly and deftly fitted to the great cylinder, and the work of bailding another twelve-inch gun is fairly At the right of the visitor an 8-inch gun is slowly revolving in a lathe, and at the same time receiving some needful attention to its interior struct-ure. Two of its elder brothers are now aboard the are a dozen guns, more or less, which have been comsent to the proving ground to be tested. Now come men bearing a long brass rod, at one end of which is a five-pointed gauge—a "star gauge"—which the operator opens and closes at will. This is adjusted, and the in-

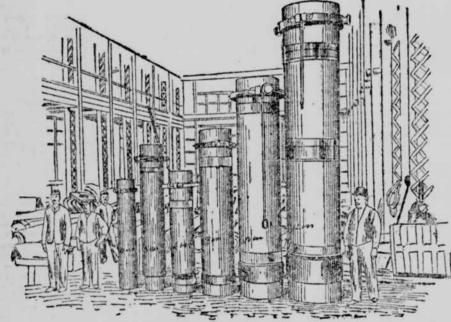
gun is now ready to be sent to the "riding machine." Descending from the elevated platform, the visitor turns to the left, and at every step encounters guns and parts of guns in all the different stages of construction, from the rough-turned and bored tubes, Jackets, hoops and other forgings of different calibres, 4-inch to 10-inch, to gans which have been

by inch, and the result duly recorded in a book. This

NORTH GUN SHOP, WASHINGTON FOUNDRY. To the visitor who knows little or nothing about big guns or gun-making the scene which opens before him as he enters the main or middle door of the imwhich furnish steam power for all the engines in this The visitor discovers, however that the Naval Gun Factory is not yet complete, and he is informed that nine more powerful machines ar now building in Philadelphia for the "North Gut Shop," and that when they are completed and set up this establishment, if not as large as some others rank among the best equipped gan factories of the

world. How many men are employed? is a question which the visitor naturally asks, and he is informed that the total number is 901. Of these 560 are skilled me chantes. For several months past they have been working ten hours a day on account of the urgent demands for new guns. A more intelligent and skilful body of men cannot be found in any manufacturing establishment; they take an interest in their work, and are proud of its quality, which is unsurpassed by any gan factory in the world, and in amount per man is unequalled.

The importance of modern gun-making as a domestic industry is so great, in a National as well as in an economic sense, that a brief account of its birth and progress and of the processes employed cannot full to be of general interest. Seven years ago there was not to be found aboard any ship of the United States Navy a single piece of modera heavy ordnance, and the United States was without a properly equipped Still further to the right, lying in a row, factory for the manufacture of heavy guns. was no private establishment in the pleted, weighed and marked, and are now ready to be furnish steel forgings for guns exceeding a calibre of six inches. Despite many difficulties one six-inch withstood the severe tests to which it had been subternal diameter of the gun is carefully measured, inch tracts with English manufacturers had been made for three sets for ten-inch guns. tions and limitations of modern heavy gun manufacture "rifled" and "lapped" and are ready to have the in the United States two years after Congress had



GUN JACKETS, 4-INCH TO 12-INCH.

breech-plugs and "mushrobms" fitted and the "sights" Among the latter are three huge 10-inch guns, which, to the visitor, seem to be big enough and destructive enough for all practical purposes. he is peering through one of these, admiring the clean, perfect rifling and beautiful finish, there is a sudder clong and clutter of machinery overhead, and he looks up to see the 40-ton travelling crane moving an 8-inch gun to the rifling machine—the fourteen tons of steel being carried and handled with as much apparent ease as an athlete would handle a fourteen-pound dumb-Another clutter is heard overhead, and the 15ton crane, is seen bringing to a boring machine a smaller mass of steel, weighing four or five tons, which in a few weeks will be converted into a 5-inch short, guns and parts of guns of every callibre and in every stage of development are seen on every hand, undergoing a variety of processes, or being moved from place to place with the help of the travelling cranes, each of which is operated by a single man who manipulates levers in a little cage. wonder, then, that the visitor is bewildered and halfdistracted. And yet there is little noise except the clatter of the travelling cranes, and even that Commander Pendleton proposes to abolish-and what to the visitor appears to be the height of confusion and in reality, perfect system and order. Every one of these alert, intelligent and shifful men knows his place and his duty; his tools are in perfect order and always at his bond; the machinery moves and works with the case and precision of clockwork, and with less noise than the fretful steaming which puffs and shricks and vexes the smooth water a couple,

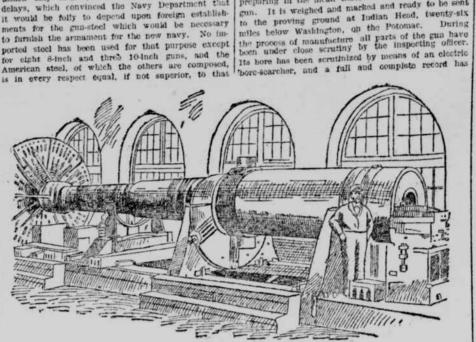
Leaving the gun-shops and turning to the right, the visitor faces a big cluster of brick buildings which surround a quadrangular court. The first one which scores of busy worken building "mounts" for the for the Atlanta, Boston and Chicago, but so indehe enters is the gun-carriage shop, in which he finds new heavy guns, as "oil as " mounts" and "shields"

of hondred yards away.

authorized the building of four new vessels for the the fourth seven-tenths completed. The combined armament of these vessels, in main batteries, was to been fairly liberal in providing for the building of the street that much larger in diameter than the bornew ships, but had falled to make adequate provision of its jacket. When both tube and jacket are ready for arming them when built. In February, 1884, the action thereon was taken at that session, and nearly three years elapsed before adequate appropriations were available either for gun forgings or the building and equipping of the naval gun factory at Washington, which had been carnestly and repeatedly urged. The subsequent action of Congress, although tardy, overhead crone from the furnace and swung over its was liberal, and its good results are already seen in

At the outset the Ordnance Eureau of the Navy decided to adopt for the armament of new vessels which might be authorized steel built-up breech-loading guns of high power, and the first set of forgings was edered for a 6-inch gan in June, 1882, from the Midvals Steel Works, and the gun was built in what was then known as the "Ordance Machine Shop," at the Washington Navy Yard. This was a shop of limited capacity, intended for miscelleneous work, and its appliances for the construction of modern guns, even of the smaller calibres, were of a primitive ind, and many expedients were necessary in order to handle and complete the first 6 inch gan, the building of which occupied many mouths. The Ord-musoo Eureau was in dead earnest, however, and forsngs were ordered for the 5-inch and 6-inch guns quate were the Government appliances and facili- | finished. The piec, next goes to the riding-machine

ties for making guns that it was found necessary to have eleven of them manufactured in private foun-dries. Four of the 8-inch guns for which forgings were obtained in England, were built in the same foundries. It is proper to remark here that the 8-inch and 10-inch forgings ordered from abroad were ob-tained only after the most tedious and vexatious delays, which convinced the Navy Department that it would be fully to depend upon foreign establishments for the gun-steel which would be necessary to furnish the armament for the new navy. No imported steel has been used for that purpose except for eight 8-inch and three 10-inch guns, and the American steel, of which the others are composed, is in every respect equal, if not superior, to that



THE 12-INCH E. L. RIFLE IN LATHE.

which was obtained from England. In order to do been made covering its features at every siep, which mesticate the manufacture of gun and armor steel is submitted from time to time to the chief inspector in the United States, it was necessary to offer extraordinary inducements, which was done in 1887, the manufacture. The average weight of a set of when bids were invited for all the steel required for forgings for each calibre is as follows: the guns and armor of all the vessels then building or authorized. The bid of the Bethlehem Iron Company was accepted, and that company at once began to establish a plant for the heaviest gun forgings and armor-plates. The company agreed to have its plant completed for the delivery of gan-forgings by August 1, 1888, prior to which time it had received an order for forty-six 6-inch, four 8-inch, twenty-four 10-inch and two 12-inch forgings and a contract for thirty-two Ginch forgings and a contract for thirty-two of inch forgings had also been made with the Midvale Company, which has also furnished a number of forgings for 4-inch and 5-inch guns. The Bethlehem Company furnishes fluid compressed steel, forged by hydraulic presses, and that from Midvale is forged under heavy steam humpers. The first Clark gun under heavy steam hammers. The first 6-inch gun built is now on board the Dolphin, and has been fired upward of 300 rounds.

The first forgings of tubes and jackets were furnished solid by the contractors, rough-bored by the Government, and then returned to the makers for cough-bored and turned, off-tempered and annualed, and are required to be as near the dimensions of the thished gun as the risk of machine work will allow. As soon as forgings are received they are evanish. at the place where they are made, and are weighed powder charges, weights of projectiles, and thickness and measured, to ascertain if they conform to the of steel which the shell will perforate at the muzzle: necessary requirements. The forgings are tested at the works for tensile strength, elastic limit, and elongation, and the result in each case is submitted to the Durcau of Ordnance, and if found satisfactory the forgings are provisionally accepted, subject to their being "machined," lest any defects should be revealed by the latter process. The Ordnance Bureau 13-incl assigns the forgings to each gun in accordance with

which was obtained from England. In order to do | been made covering its features at every step, which

and is rifled, then to the breech-slotting machine, where the blanks are cut in the scrow-box for the

After riding, the bore is rubbed down, or "Imped"

as it is termed, with a lead weight and with oil and emery to take the rough edges off the rifling.

The breech mechanism and sights, which have been

It is weighed and marked and ready to be sent

preparing in the mean time, are now adjusted to the

forgings for each calibre is as follows:
4.4nch 4.850 \tau_1 \text{mished gun,} 3.280 \text{m}
4.4nch rapld fire 5.800 \tau_1 \text{mished gun,} 3.400 \text{m}
4.4nch rapld fire 10.800 \tau_1 \text{mished gun,} 3.400 \text{m}
5.4nch 5.4nch 5.800 \text{m} \text{mished gun,} 7.000 \text{m}
5.4nch rapld fire 9.300 \text{m} \text{mished gun,} 7.000 \text{m}
6.4nch 5.800 \text{m} \text{mished gun,} 7.000 \text{m}
6.4nch 5.800 \text{m} \text{mished gun,} 7.000 \text{m}
9.400 \text{m}
10.4nch 72.400 \text{m} \text{mished gun,} 29.400 \text{m}
10.4nch 127.480 \text{m} \text{mished gun,} 16.300 \text{m}
12.4nch 127.480 \text{m} \text{mished gun,} 6.300 \text{m} The following table gives the number of sets of

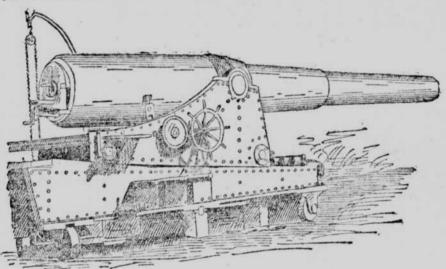
forgings thus far ordered, according to the last report of the Bureau of Ordnance, the number of guns completed, and the number of guns in course of construction at the gun foundry, forgings for which have been

No. guns No. in No.forgings com- course of ordered, pleted, c'nstr'ct'n. A 13-inch gun, 455 inches in length, has been

As soon as lorgings are received they are examined the designs of the marks of the Government inspector stationed various calibres, their total lengths, weights of

W't in Lengthcharge, projectile capacity,

The range of each calibre is assumed to be one mile its physical properties, and also prescribes the amount for each inch of diameter of bore; for example, the



THE 10-INCH. B. L. STEEL RIFLE.

completed with the inadequate tools and appliances to be found at the Washington Navy Yard, and had prises the tube, which is the body of the gun; the The total length of each gun is as follows: Fourjacket, which is a heavy forging, nearly one-third the length of the tube and which envelops its breech; calibres, 226 inches; eight-inch, 35 calibres, 304.5 twenty sets of six-inch steel gan forgings had been hoops, varying in number according to the size of the inclus; ten-inch, 35 calibres, 357 inches; twelve luch, made and eight sets had been declined, two at the gun, and a breech plug and a "mushroom," which south Boston works and four in Washington, and conderives its name from its shape. It extends through mean the total length of a gun, but the length of the conderives its name from its shape. the breech plug, and its office is to prevent the escape | the rifled bore and powder chamber. In all the guns or eight-inch guns and through the breech of gases liberated by firing. The except the small rapid-firing guns, the rifled grooves such were the condiphysical requirements of gun-steel, as shown by test are multiples of four; a ten-inch gun has ten times eight sets of steel forgings for eight-inch guns and through the breech of gases liberated by firing. The pieces 2 inches long by 1-2 tach in diameter, are, in four grooves, a six-fach gun six times four, etc. ceneral terms, as follows:

Tensile Elastic limit. The contracts for gan forgings call for open-hearth

are required to have an excess of weight of 40 per replaced by two eight-inch guns; and two ten-inch cent above that of the rough-bored forging. Of this guns for the Miantonomoh, which have been completed upper end of the ingot and one-eighth from the lower included. All of these gans except four eight-incl

of the "raw material" of a modern gun for one of the tean steel.

new ships of the American Navy. After that one is It is expected that before July 1, 1891, twenty-four has stood the severest tests applied to it.

save been prepared as above described are converted in various states of manufacture thirty-one four-inch into modern gans, every part of which is as perfectly gans, twenty-four five-inch gans, six six-inch gans, finished and as accurately adjusted as the parts of three eight-inch gans, two ten-inch gans and three a watch, and which are not surpassed if they are twelve-luch guns, one of the last named being well equalled in finish, accuracy, strength or effectiveness advanced toward completion. by like guns made in the best gun factories of Europe. The tubes, as received, are put in a boring and turning | Factory is rated as follows: | Forty five-inch or fourlathe and a true bore smaller in diameter by about one- inch, sixfy six-inch, ten eight-inch, six ten-inch and quarter of ap inch is obtained. The jacket, which is three twe've inch guns. With the present machinery the first place to be shrunk on, is in the mean time and appliances the average that required to build a bored to its exact diameter and measured in every (gun of each calibre is as follows: Four-inch, tifty inch by means of the star-gauge. These dimensions having been obtained, that part of the tube which is Navy-one of which had been completed and one launched, while a third was ready to be launched and to be enveloped by the jacket is turned down to what onsist of two five-inch, twenty-one six-inch and eight | for the shrinkage of the parts in question; on a sixeight-inch breech-loading steel rifles. Congress had sinch tube it is about 12-100 of an inch, and the tube attention of Congress was called to the necessity of with its breech or rear end up, and the jacket is placed making suitable provision for the manufacture of in the heating furnace, where it is expanded sufficiently modern ordnance for both the Army and Navy by to pass over the tube, with allowance for the necessary the first report of the Gun Foundry Board, but no time required to perform the operation. The expanded time required to perform the operation. The expanded piece is never raised above a black heat, nor is the expansion allowed to exceed 5-1,000 of an inch for each tuch of diameter and it is usually less.

The expansion is watched by means of trial gauges

and when sufficient the heated piece is lifted by the tube and being carefully plumbed is lowered slowly t its seat. Running water is circulated through the bore of the tube, and when the mass is cold the gur is lifted from the pit and its bore is star-ganged to ascertain what compression has taken place, due to the squeeze of the contracting jacket. This compression is a measure the test of the accuracy of the work un to this point. The various hoops have in the time been bored and measured, and the exterior of the jacket and uncovered end of the tube are prepared to receive them in the same manner as the reor end of the tube was prepared for the lacket, and each one is put on in its proper order until the gun is fally assembled. The bore is star gauged before each layer of overlapping parts, to ascertain the total mount of compression

When fully built-up, the gon is bored to finished atnonsions, the powder chumber is bored out and the screw cut for the Levech plug and the exterior is

of shrinkage to be applied to each part. It may be range of a six-inch gun is six miles, of a ten-inch gun

Every gun is sent to the proving ground, where it is thoroughly tested before it is issued for use. The statutory test" required by law is ten rounds fired Part strength strengt been completed and issued to vessels as follows: Five steel of domestic manufacture from the best quality of | inch, two; str-inch, ninety-eight; eight-inch, fourteen; raw material, uniform in quality and free from all | ten-inch, two. Of the ninety-eight str-inch guas, four defects. The mefal is first run into solid ingots, which which were issued to the Charleston have since been excess, three-fourths must be discarded from the and tested but not yet issued and mounted, are not end. All forgings must be annealed, oil-tempered and twenty-three six-inch were made in the Naval Gun Factory at Washington, and all of them except eight Ss much for the preparation, inspection and tests eight-inch and three ten-inch guns are made of Amer-

not surprised to learn that every gun built thus far more six-inch guns, four more eight-inch guns, and has stood the severest tests applied to it. Now, as to the process by which the forgings that | for service, Besides these there are in the gun factory

The present annual capacity of the Naval Gut

facture was reduced from 225 days in 1858 to 120 days in 1860. The ten-inch gain, whitch cost \$84,354 un nearby the site of the new factory at Watervlich to build in the gain factory in 1885, cost only \$3,500 in 1800, and the time was reduced from 240 days to 164 days. There has been a great decrease also in the cost of manufacture of gun carriages. The cost of manufacture of gun carriages also in the first ion six lach curriages averaged \$3,556.31.

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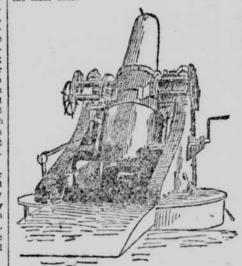


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THE 12-INCH B. L. MORTAR.

The present annual capacity of the Naval Gub Partry is rated as follows: Porty five-inch or four first, sixty six-inch, ten cight-inch, sixt ten-inch and three twe'evbinch guns. Will the present machinery and appliances the average (see required to build a gun of each calibre is as follows: Pour-inch, fifty days; five-inch, dift days; atsinch, sixty days; eisty da

N. K. FAIRBANK & CO., MANIFACTURERS, CHICAGO, ILLINOIS, OFFICIA AND DIFFOT, 103 N. PRONT STREET, PHILADRIPHIA.

The cost of this ghat her averaged SQLARQ, and, the cost of the fifth first average and every every conference of the cost of the fifth first average and every every conference of the cost of the fifth first average and every every conference of the cost of the fifth first average and the cost are mainly dish as politicate, and to her cost are mainly dish as politicate, and to her cost are mainly dish as politicate, and to her cost are mainly dish as a politicate, and the cost of the cost

A regular system of collecting second hand clothes will be started throughout the city, and this will give some of the men work in repairing and cleaning. The home will be only nominally self-supporting, however, for, while nothing will be furnished without its being worked for, the value of the pay will be much larger than the work would ordinarily amount to. None of the inmates will be allowed to remain in the home longer than a certain time (probably about sixty days), which, it is thought, will be long chough to give them a good start in the world and to fit them out with clean clothing and with tools for such men as are mechanics. The home will be managed on the broadest principles, being entirely ion-secturian, and the inmates will be under no constraint, except that of leaving their evil habits.

This home for men will be followed in the fail by a home for women on the same principle, which will probably be situated near the other, and which will be inder the same management. A large mission in the slums" will also be started, and another important step will be the founding of industrial farms within a convenient distance of New-York, to which the Alliance will send such men as can be benefited more by a country life. All this, however, Mr. Milbury said yesterday, reversing the old adage, is morely an ounce of The Alliance intends to use a pound of prevention, by getting hold of the little children of the poor, and in using mission-workers to bring them into day-nurseries and kindercartens which will be esthe day-nurseries and kindersarens which will be tablished. There they will be cared for and gradually educated for either the public schools or for the industrial schools which will be opened by the Allianos, where they will be taught to use their hands and tables.

INSURANCE MEN ONGANIZING.

Samuel P. Blanden, president of the New-York Board of Fire Underwriters, appointed yesterday a committee of fifteen to consider the ways and means of reviving the Disurance Tariff Association of this city. The committee consists of M. A. Stone, of the Greenwich Company; J. H. Washburne, of the Home; J. W. Murray, of the Angio-American; Hugh Schumann, of the Germania; G. F. Boddall, of the Royal; W. W. Under hill, and B. Ackerman, agents; G. H. Eaton, Liverpool Lordon and Globe; A. D. Irving, Phoenix of London; H. H. Hall, agent; J. A. McDonal, Queen; J. A. Alexander, agent; W. H. Crolius, American; J. R. McKay, 17., Phoenix of Hariford, and B. Lockwood, Western

American. It is expected that this committee will settle upon the expected that the rates will be regulated and the business put on a paying basis. It is said that a number of insurance firms have been doing a besing business for some time, and that a system of regular rates is needed to prevent their going out of business.

COLORED BAPTISIS ELECT OFFICERS.

The convention of colored Baptist-ministers which to now in session at the Abysshian Baptist Church, in Waverly Place, elected the following clergymen officers yesterday : President, Dr. Rufus L. Perry, of Brooklyn; ctce-president, George H. Juckson, of New-Haven, Conn.; recording secretary, Dr. T. D. Miller, of Philadelphia, Penn.; corresponding secretary, William T. Dixon, of Brooklyn; treasurer, R. D. Wynn, pastor of the Abyssinian Bapilat Church of New York. Committees were appointed on finance, on application of new charches, on credinitals, on education, on tem-perance and on obligaries.